REMARKS

This Preliminary Amendment cancels, without prejudice, claims 1 to 12 in the underlying PCT Application No. PCT/DE2004/001702 and adds new claims 13 to 28. The new claims, inter alia, conform the claims to United States Patent and Trademark Office rules and does not add any new matter to the application.

In accordance with 37 C.F.R. § 1.125(b), the Substitute Specification (including the Abstract) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to United States Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. §§ 1.121(b)(3)(ii) and 1.125(c), a Marked-Up Version of the Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

The underlying PCT Application No. PCT/DE2004/001702 includes an International Search Report, dated April 8, 2005, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

It is respectfully submitted that the subject matter of the present application is new, non-obvious and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully submitted,

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METHOD FOR MANUFACTURING AND/OR REPAIRING COMPONENTS FOR GAS TURBINES

FIELD OF THE INVENTION

The present invention relates to a method for manufacturing and/or repairing components, ~~particularly~~ **e.g.,** blades and blade segments, for gas turbines, ~~particularly~~ **e.g.,** for aircraft engines.

BACKGROUND INFORMATION

Modern gas turbines, particularly aircraft engines, must satisfy the highest demands with respect to reliability, weight, performance, economic efficiency and durability. In the last decades, aircraft engines were developed, particularly in the civil sector, which fully satisfy the above requirements and have achieved a high degree of technical perfection. Among other things, the selection of materials, the search for new suitable materials and the search for new manufacturing methods and repair methods play a decisive role in the manufacture and also in the repair of aircraft engines.

Numerous methods for manufacturing and repairing components for gas turbines are ~~known from the related art~~ **conventional**. This includes, among other things, forging and investment casting. Thus, ~~according to the related art~~ **conventionally**, all highly stressed components in the compressor region of a gas turbine are manufactured by forging, whereas the rotor blades, for example, as well as the stator blades of the turbine are investment casting parts. Particularly milling from the solid or joining of finished blades to a rotor holder or a hub by linear friction welding are used in the manufacture of gas turbine rotors having integral blading, of so-called blisks (bladed disks) or blings (bladed rings).

Another **conventional** method ~~known from the related art~~ for manufacturing and repairing or restoring blades for gas turbines is the so-called laser-powder build-up welding, which is also called laser beam build-up welding or laser beam generation. ~~According to the related art~~ **Conventionally**, laser-powder build-up welding is used particularly in maintenance work and restoration work. Thus it is ~~known from the related art~~ **conventional** for blades, which have a short blade length as a result of wear, to be restored by laser-powder build-up welding so that the blades may be reinstated more frequently and consequently do not have to be sorted out prematurely.

A method for manufacturing or restoring blades for turbo engines by laser beam build-up welding is ~~known from~~ **described in German Published Patent Application No.** [[DE]] 195 47 903 [[C1]]. In the method disclosed therein, a strip of sheet metal is used as a support form. Following the extension of the blade by laser build-up welding, the sheet metal strip is removed and reused.

SUMMARY

~~Using this as a starting point,~~ **Example embodiments of** the present invention ~~is geared toward the objective of providing a novel~~ **may provide a** method for manufacturing and/or repairing components for gas turbines.

~~This objective is attained in that the method mentioned at the outset is refined by the features of the characterizing part of Claim 1.~~

According to **example embodiments of** the present invention, laser-powder build-up welding [[is]] **may be** performed using at least one substructure, the material build-up by a powder

material occurring in the process of laser-powder build-up welding [[in]] such ~~a way~~ that the or every substructure is at least in sections enclosed by the built-up powder material. Following the laser-powder build-up welding, the substructure used in the method ~~according to the present invention~~ **hereof** remains inside the manufactured or repaired component and thereby becomes an integral part of it. This ~~results~~ **may result** in a multitude of new design possibilities for gas turbine components, ~~particularly~~ **e.g.,** for stator blades, rotor blades, stator blade segments, rotor blade segments or rotors having integral blading for aircraft engines.

~~According to an advantageous further development of the present invention, a~~ **A** blade for a gas turbine [[is]] **may be** manufactured in that in laser-powder build-up welding a substructure made of a dampening material is enclosed on all sides by the built-up powder material such that the substructure is subsequently positioned in the interior of the manufactured blade. The blade ~~is in particular~~ **may be, e.g.,** a hollow blade for a gas turbine, the dampening substructure ~~preferably~~**, e.g.,** completely filling a hollow space of the manufactured hollow blade.

~~According to an alternative advantageous further development of the present invention, a~~ **A** gas turbine rotor having integral blading [[is]] **may be** manufactured in that a substructure made of forged, cast or powder-metallurgically manufactured material is enclosed by the built-up powder material in the process of laser-powder build-up welding.

~~Another method according to the present invention for manufacturing and/or repairing components for gas turbines is characterized by the features of independent Claim 11.~~

Preferred ~~further developments~~ **details and aspects** of the method according to **example embodiments of** the present invention are ~~revealed by the dependent claims and the following description~~ **described in more detail below with reference to the appended Figures**.

~~Exemplary embodiments of the present invention are explained in detail in light of the drawing without being limited to it. The figures in the drawing show:~~

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1[[:]] **is** a ~~cross-section~~ **cross-sectional view** of a blade of a gas turbine in a schematized perspective lateral view[[;]].

Fig. 2[[:]] **illustrates** a blade segment of a gas turbine in a schematized perspective lateral view[[; and]].

Fig. 3[[:]] **illustrates** a gas turbine rotor having integral blading in a schematized perspective lateral view.

DETAILED DESCRIPTION

In the following, **example embodiments of** the present invention ~~will be~~ **are** described in greater detail with reference to [[Fig.]] **Figs.** 1 ~~through~~ **to** 3. Fig. 1 ~~shows~~ **illustrates** a blade of a gas turbine manufactured using the method according to **an example embodiment of** the present invention. Fig. 2 ~~shows~~ **illustrates** a blade segment, and Fig. 3 ~~shows~~ **illustrates** an integrally bladed gas turbine rotor.

Fig. 1 ~~shows~~ **illustrates** a rotor blade 10 for a gas turbine ~~comprising~~ **including** a blade root 11 and a blade 12. Fig. 1 shows a ~~cross section~~ **cross-section** of blade 12, it being possible to gather from Fig. 1 that rotor blade 10 takes the form of a hollow blade 10. A wall 13 of blade 12 delimits a

hollow space 14, a core 15, **e.g.,** made of a ~~preferably~~ dampening material being ~~situated~~ **arranged** in hollow space 14. In the exemplary embodiment shown, core 15 made of a dampening material completely fills hollow space 14.

~~In accordance with the present invention, rotor~~ **Rotor** blade 10 as ~~shown~~ **illustrated** in Fig. 1 is manufactured in that core 15 made of a dampening material is used as a substructure for laser-powder build-up welding. ~~According to the present invention, the~~ **The** material build-up occurs in the process of laser-powder build-up welding in a manner such that substructure or core 15 is enclosed by the built-up powder material. Substructure or core 15 thus becomes an integral part of rotor blade 10 to be manufactured. In the exemplary embodiment ~~shown~~ **illustrated** in Fig. 1, core 15 is enclosed on all sides by the built-up powder material. As already mentioned, core 15 is made of a dampening material which is ~~preferably~~**, e.g.,** manufactured as a metallic or ceramic felt.

Fig. 2 ~~shows~~ **illustrates** a blade segment 16, manufactured with the aid of the method according to **an example embodiment of** the present invention, having altogether four blades 17, an inner cover strip 18 and an outer cover strip 19. Thus blade segment 16 as ~~shown~~ **illustrated** in Fig. 2, for example, may be a blade segment ~~whose~~**, the** individual blades 17 **of which** in analogy with blade 10 as ~~shown~~ **illustrated** in Fig. 1 take the form of hollow blades having cores embedded in their hollow spaces.

Alternatively it is also possible, however, to manufacture blade segment 16 as ~~shown~~ **illustrated** in Fig. 2 by using in each case one cast, forged or powder-metallurgically manufactured substructure both for inner cover strip 18 and for outer cover strip 19, the individual blades 17 being built up on these substructures by laser-powder build-up welding.

Fig. 3 ~~shows~~ **illustrates** a gas turbine rotor 20 having integral blading, multiple rotor blades 22 being joined to a disk-shaped rotor holder 21. Rotor blades 22 are attached to an outer lateral surface 23 of disk-shaped rotor holder 21 and extend in the radial direction of the same ~~outward~~ **outwardly**.

Gas turbine rotor 20 ~~shown~~ **illustrated** in Fig. 3 having a disk-shaped rotor holder 21 having integral rotor blades 22 is also called a blisk (bladed disk).

~~In accordance with the present invention, gas~~ **Gas** turbine rotor 20 ~~shown~~ **illustrated** in Fig. 3 is manufactured in that for rotor holder 21 a forged, cast or powder-metallurgically manufactured disk member made of metal is used, rotor blades 22 being built up on this disk-shaped substructure by laser-powder build-up welding.

~~It is furthermore in accordance with the present invention for gas~~ **Gas** turbine rotor 20 **may** alternatively [[to]] be manufactured by using the forged, cast or powder-metallurgically manufactured substructure for the rotor holder and also for the rotor blade substructures. In this exemplary embodiment, the substructure for rotor holder 21 ~~is preferably~~ **may be** a metallic substructure and the substructures for rotor blade 22 [[are]] **may be** ceramic substructures. The metallic substructure of the rotor holder and the ceramic substructures of rotor blade 22 are then integrally joined ~~in accordance with the present invention~~ by laser-powder build-up welding, the powder-material to be built-up by welding enclosing the substructure for rotor holder 21 as well as the substructures for rotor blades 22 on all sides following the process of laser-powder build-up welding. Accordingly, an integral or form-locking joint between ceramic components and metallic

components is realizable with the ~~aid of the present invention~~ **method hereof**.

From the details of the method ~~according to the present invention~~ described in connection with ~~Fig.~~ **Figs.** 1 ~~through~~ **to** 3 it ~~directly~~ follows that the method ~~according to the present invention opens~~ **may open** up a multitude of design possibilities for gas turbine components. With the aid of the method ~~according to the present invention~~ **hereof,** it is thus possible to manufacture hollow blades around a core made of dampening material by laser-powder build-up welding. Furthermore, it is possible to manufacture blades, blade segments or gas turbine rotors having integral blading with and without cover strip by embedding cast, forged or powder-metallurgically manufactured substructures into the powder material or laser powder. It is furthermore possible to join components made of different materials in an integral manner. For this purpose~~, according to the present invention~~, laser-powder build-up welding is performed using at least one substructure, the material build-up by the powder material occurring in the process of laser-powder build-up welding [[in]] such ~~a way~~ that the or every substructure is at least in sections enclosed by the built-up powder material.

~~It is furthermore in accordance with the present invention for the~~ **The** laser-powder build-up welding [[to]] **may** be carried out in multiple stages or steps, different materials, that is, different powder materials, being used for the laser-powder build-up welding in the individual stages or steps. Metal alloys ~~are preferably~~ **may be** used as powder materials, such as nickel-based alloys or titanium-based alloys, for example. Due to the division of the laser-powder build-up welding into multiple stages and the use of different powder materials, it is possible to construct subassemblies, ~~particularly~~ **e.g.,** blades, for gas turbines from different metal alloys and thus

to optimize the properties of the same. Thus, in repairing a blade, it is also possible to extend the blade by building up the extension by welding from a different material than the material of the blade. It is furthermore possible to use different materials for the rotor blades and the rotor holder in manufacturing integrally bladed gas turbine rotors.

As already mentioned repeatedly, the method ~~according to the present invention is~~ **may be** suited for manufacturing individual blades, for manufacturing blade segments, for manufacturing gas turbine rotors having integral blading and for manufacturing other components for gas turbines**, etc**. Thus, it is also possible, for example, to manufacture fastening elements or housing sections for gas turbines using the method ~~according to the present invention~~ **hereof**. The blade segments ~~can~~ **may** be constructed with or without a cover strip and may ~~comprise~~ **include** at least two blades.

~~It should be pointed out in conclusion that the~~ **The** details of laser-powder build-up welding ~~are~~ **should be** familiar to the person skilled in the art addressed here. Very briefly only it should be pointed out that in laser-powder build-up welding the powder material is sprayed from a powder gun onto the substructure and that a laser beam heats the powder material such that the powder material is joined with the substructure or is built up by welding.

~~Abstract~~

ABSTRACT

~~The present invention relates to a~~ **A** method **is** for manufacturing and/or repairing components, ~~particularly~~ **e.g.,** blades and blade segments, for gas turbines, ~~particularly~~ **e.g.,** for aircraft engines, by laser-powder build-up welding.[[

]]~~According to the present invention, laser-powder~~ **Laser-powder** build-up welding is performed using at least one substructure, the material build-up by a powder material occurring in the process of laser-powder build-up welding [[in]] such ~~a way~~ that the or every substructure is at least in sections enclosed by the built-up powder material ~~(Fig. 1)~~.